



A long relation...

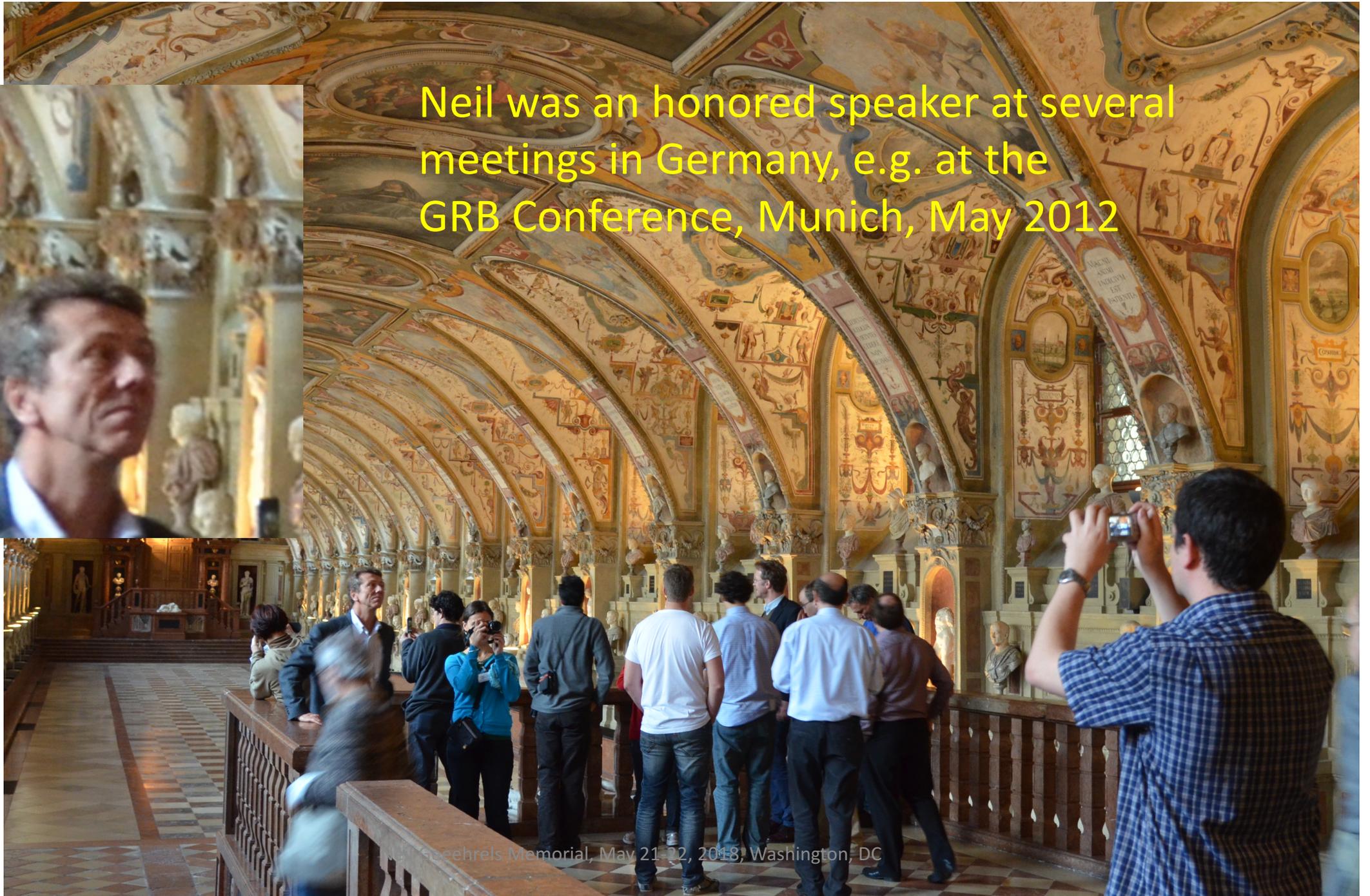
Neil Gehrels and the Max-Planck-Institut für extraterrestrische Physik, Garching:

- Chair of the Scientific Advisory Board of MPE
- since 1991 Project Scientist on CGRO and Fermi
- calibration of Swift/XRT at Panter facility (2x)

Close cooperation (notably with Jochen Greiner and Marco Ajello) on Swift data analysis and optical follow up with GROND/OPTIMA based on the **Swift Data Distribution Policy:**

EVERYTHING TO EVERYONE, IMMEDIATELY!

Neil was an honored speaker at several meetings in Germany, e.g. at the GRB Conference, Munich, May 2012



Neehrels Memorial, May 21-22, 2018, Washington, DC

How GRB070610 became the 'magnetar' candidate, Swift J1955+26

Gottfried Kanbach, Max-Planck-Inst. für extraterr. Physik, Garching

+ OPTIMA team at Skinakas Obs.

Univ. Heraklion, Crete:

Alex Stefanescu

Aga Slowikowska

Fritz Schrey



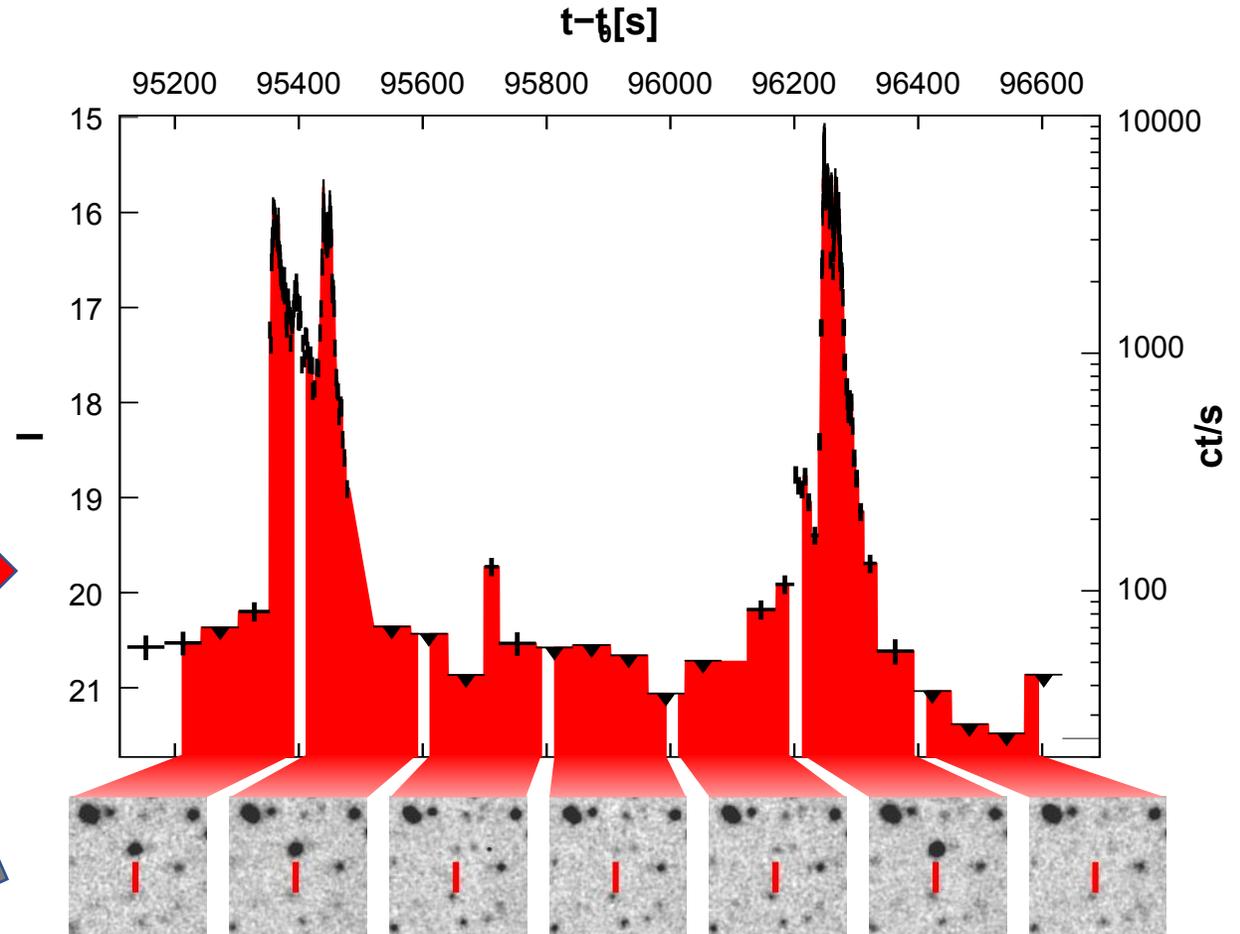
Major References:

Stefanescu et al., Nature, **455**, 503, 2008

Castro-Tirado et al., Nature, **455**, 506, 2008

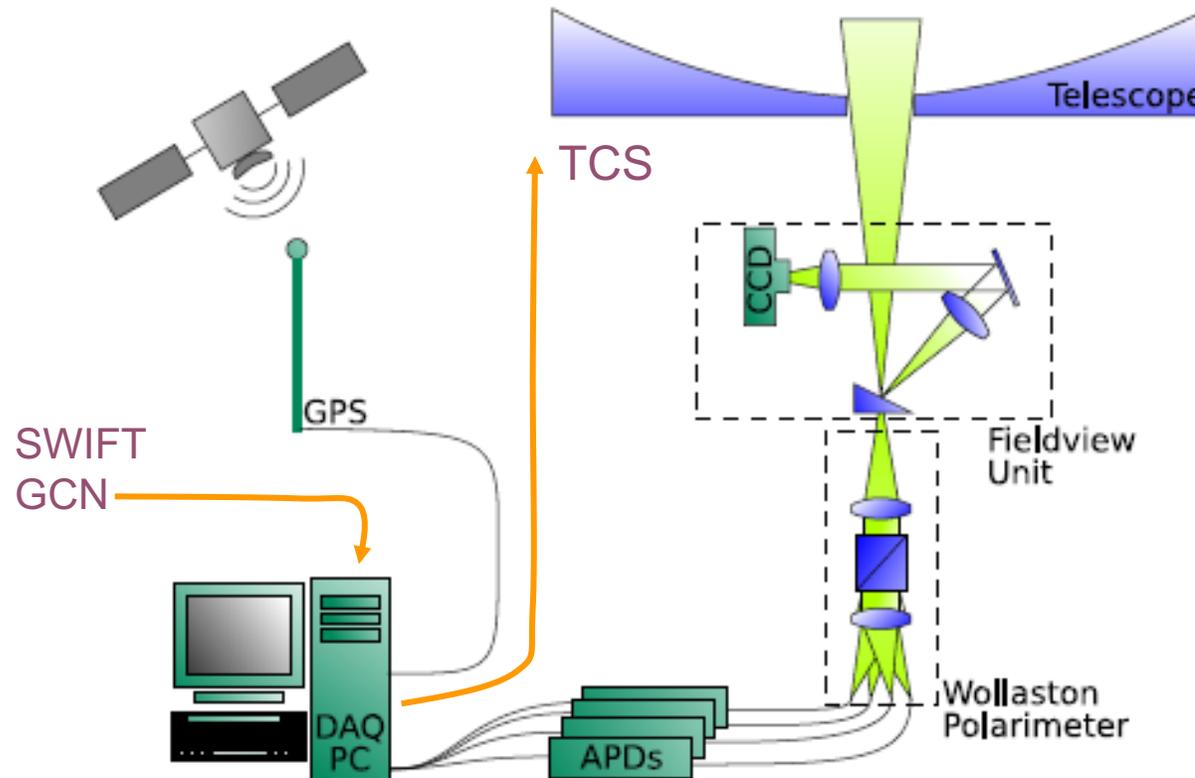
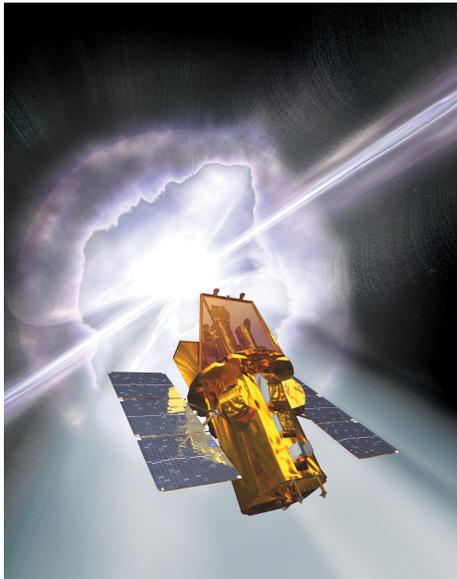
Kasliwal et al., ApJ **678**, 1127, 2008

Simon et al., MNRAS **422**, 981, 2012

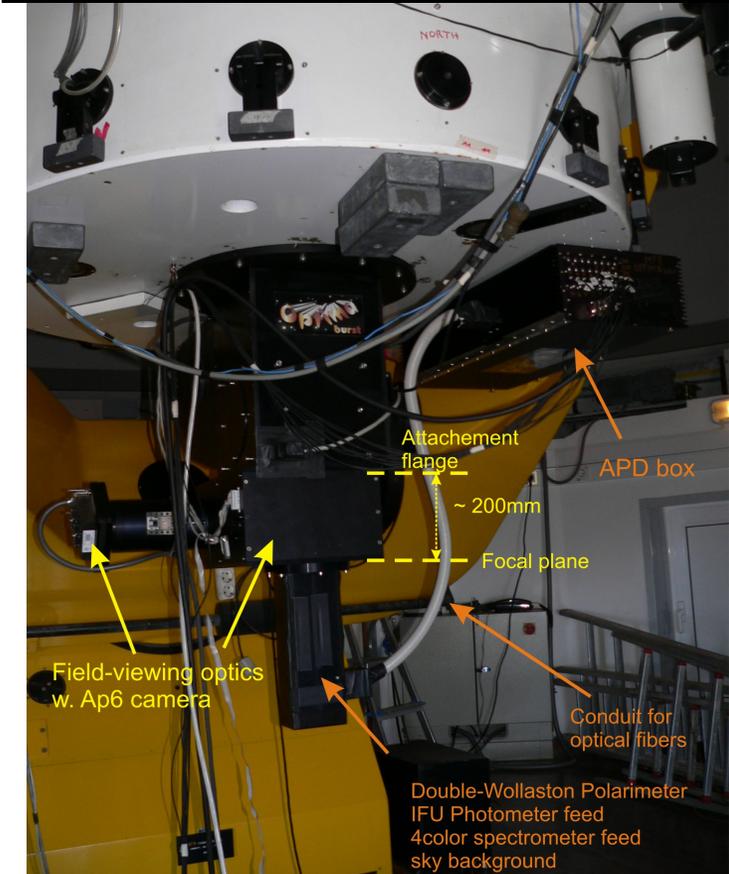


Searching for GRB optical afterglows with "OPTIMA-Burst"

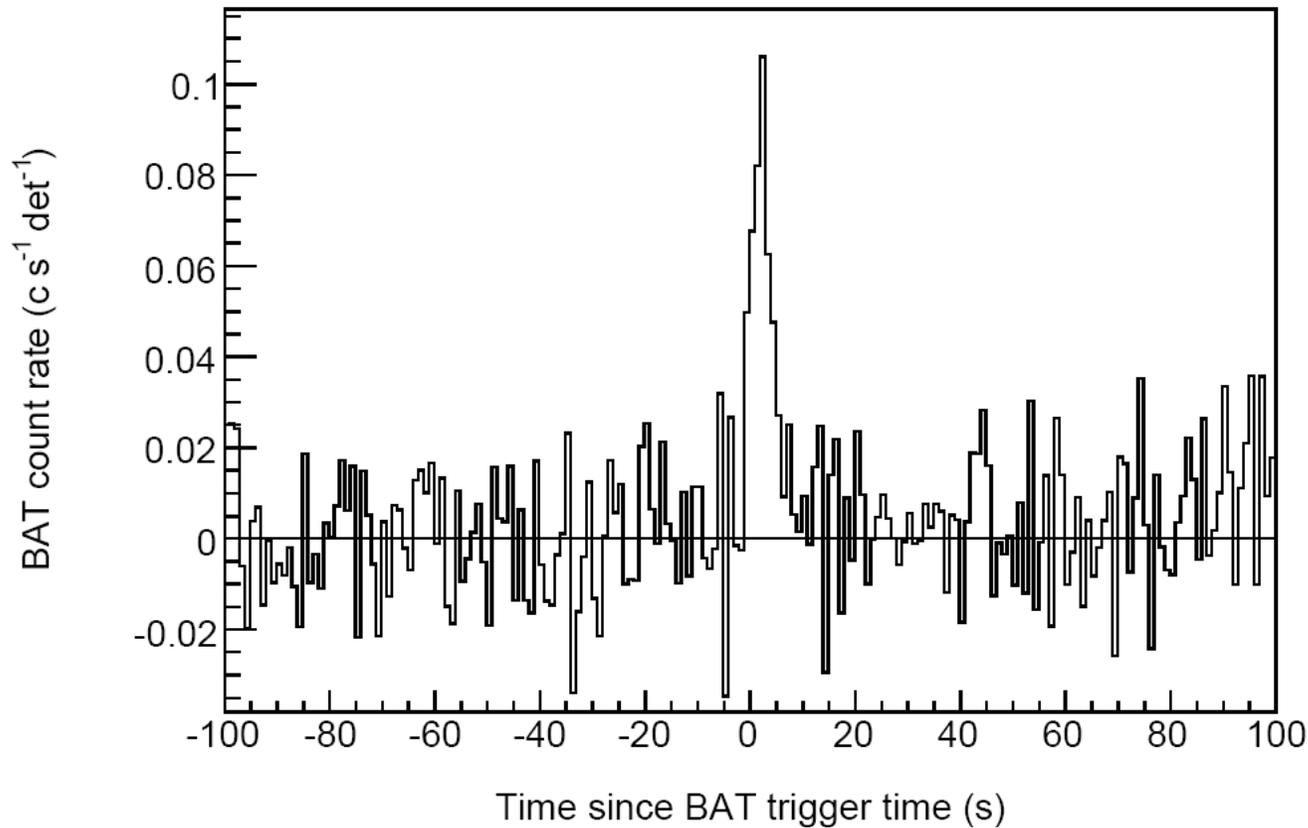
Goal: GRB intensity and polarization with sub-second time resolution
12 observable GRBs -> 4 positive detections of Ots
(Stefanescu, PhD thesis, 2011)



OPTIMA-Burst at 1.3m Skinakas Observatory, University of Heraklion, Crete, Greece



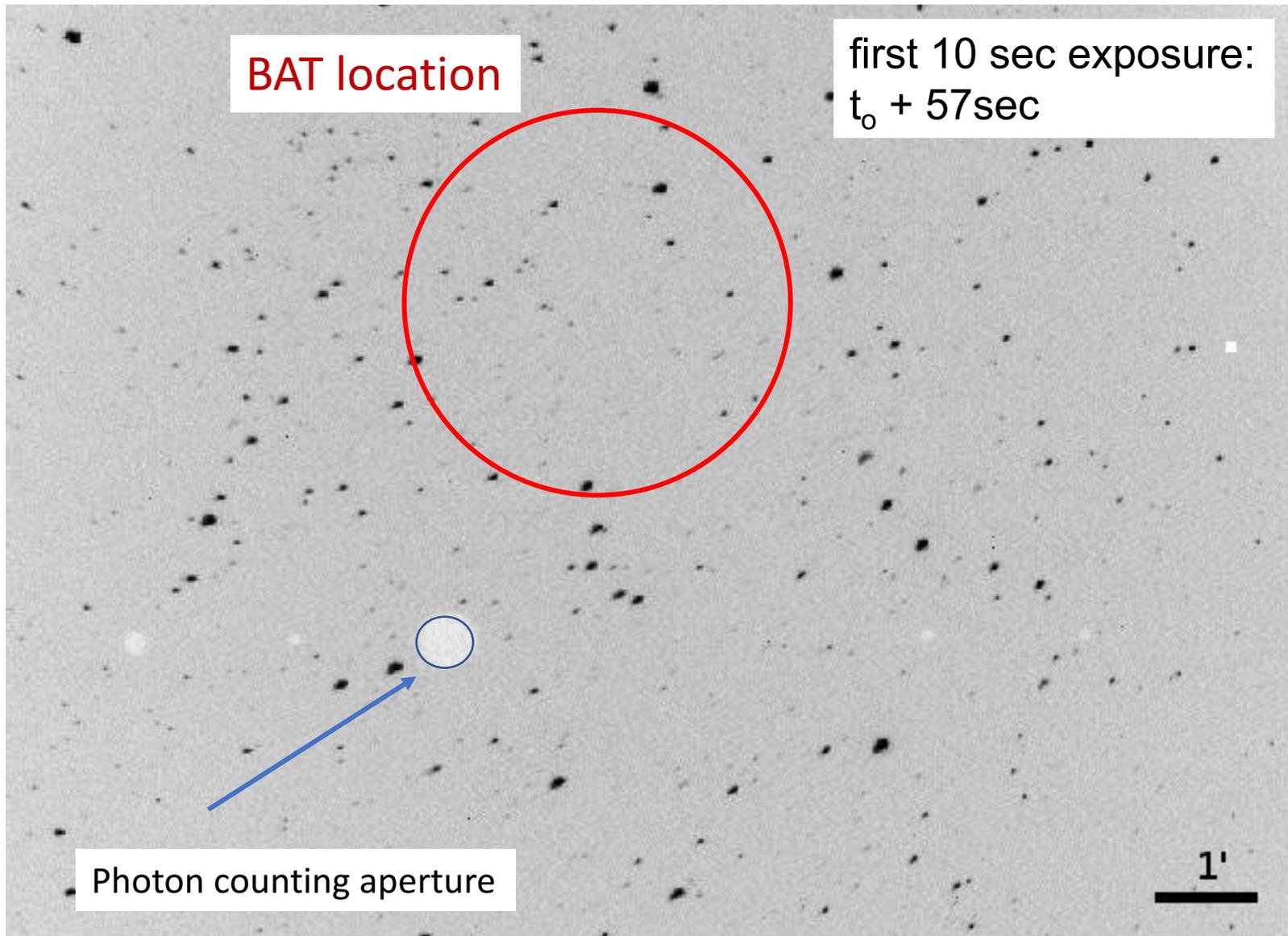
Swift BAT detected a GRB on 10 June 2007, 20:52:52 UT:

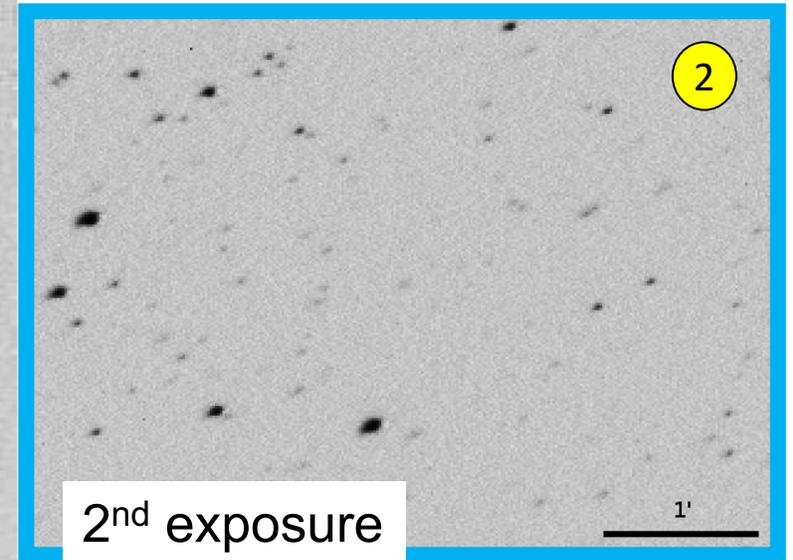
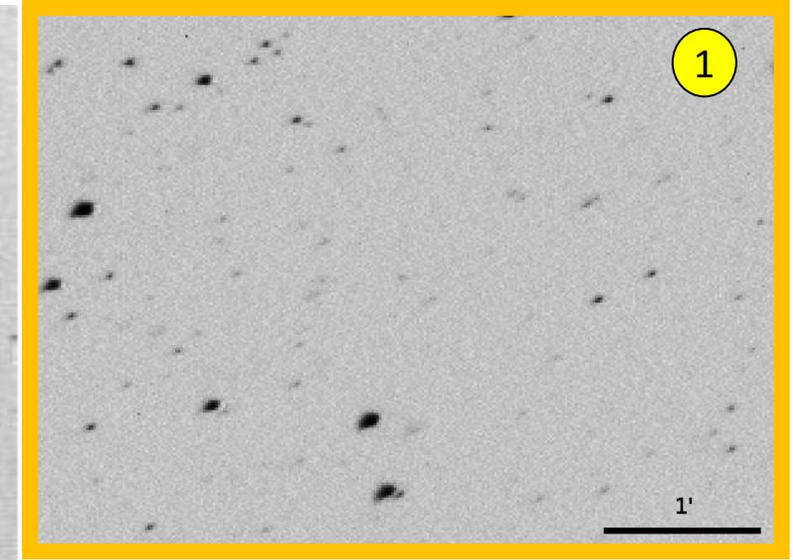
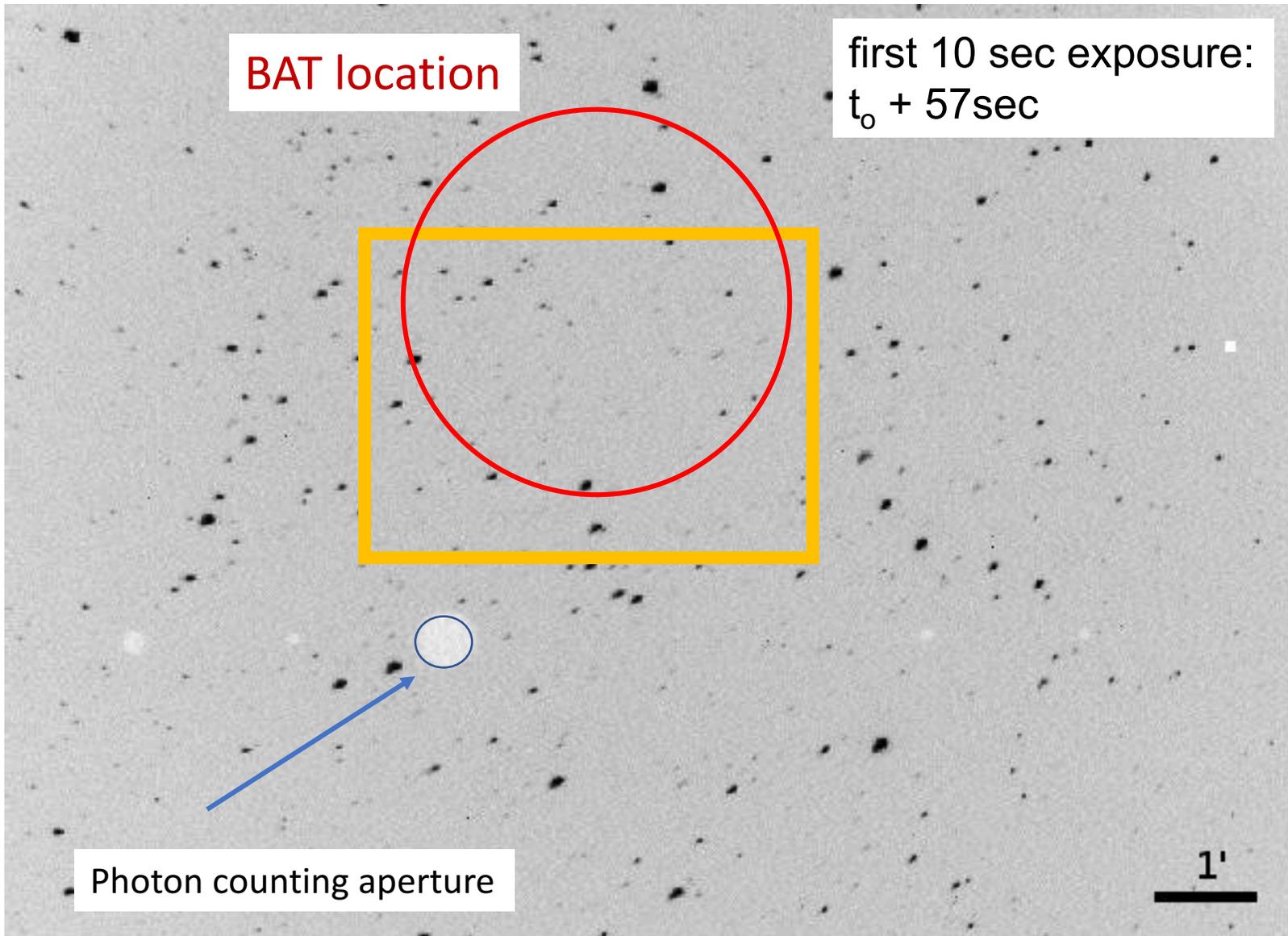


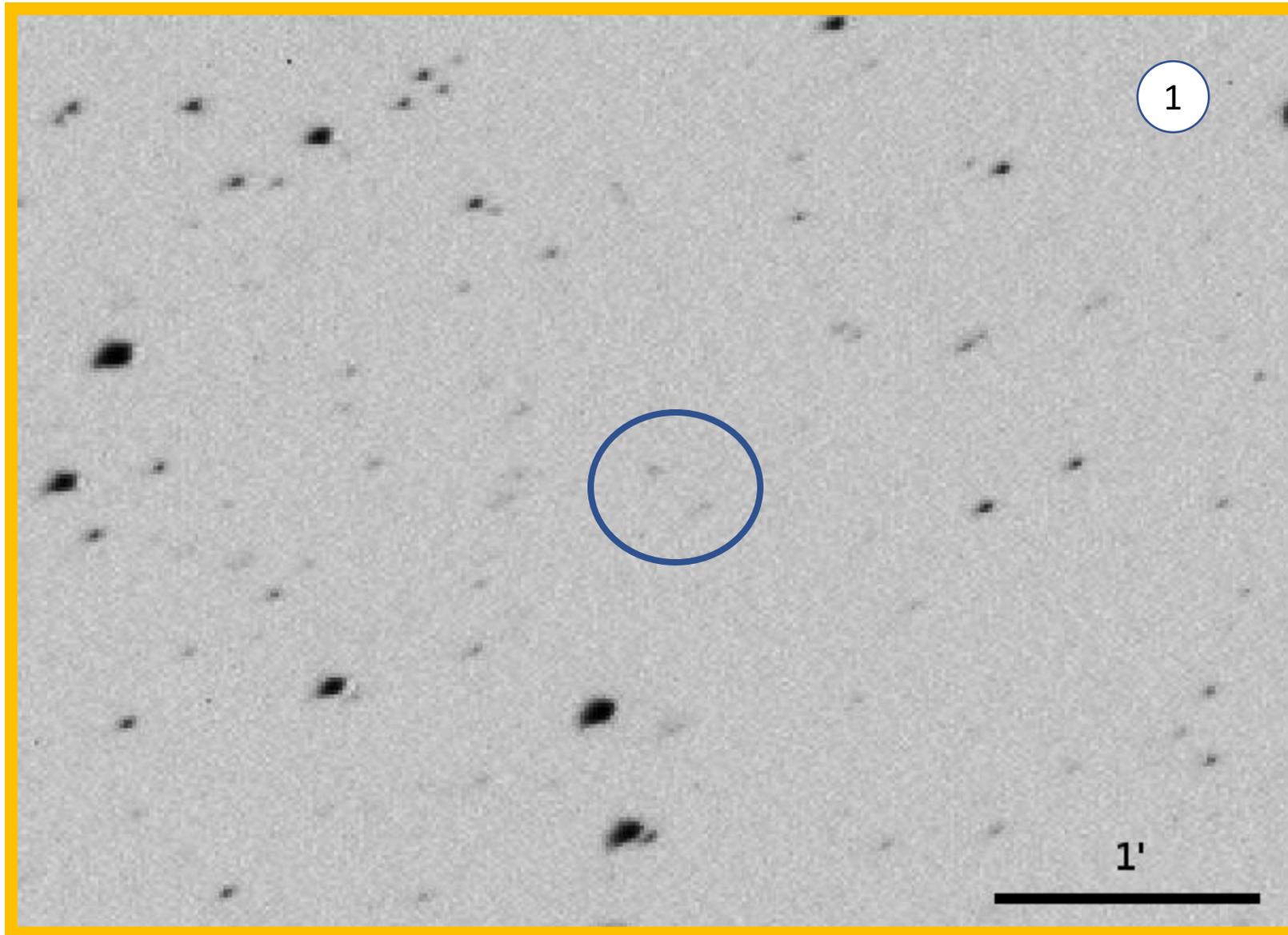
BAT GRB070610:
single peak $t_{90} \sim 4.6$ sec
localization radius 1.8'

XRT was view constrained and
could only observe after
 $t_0 + \sim 3000$ sec (50 min)
-> localization radius 4.3''

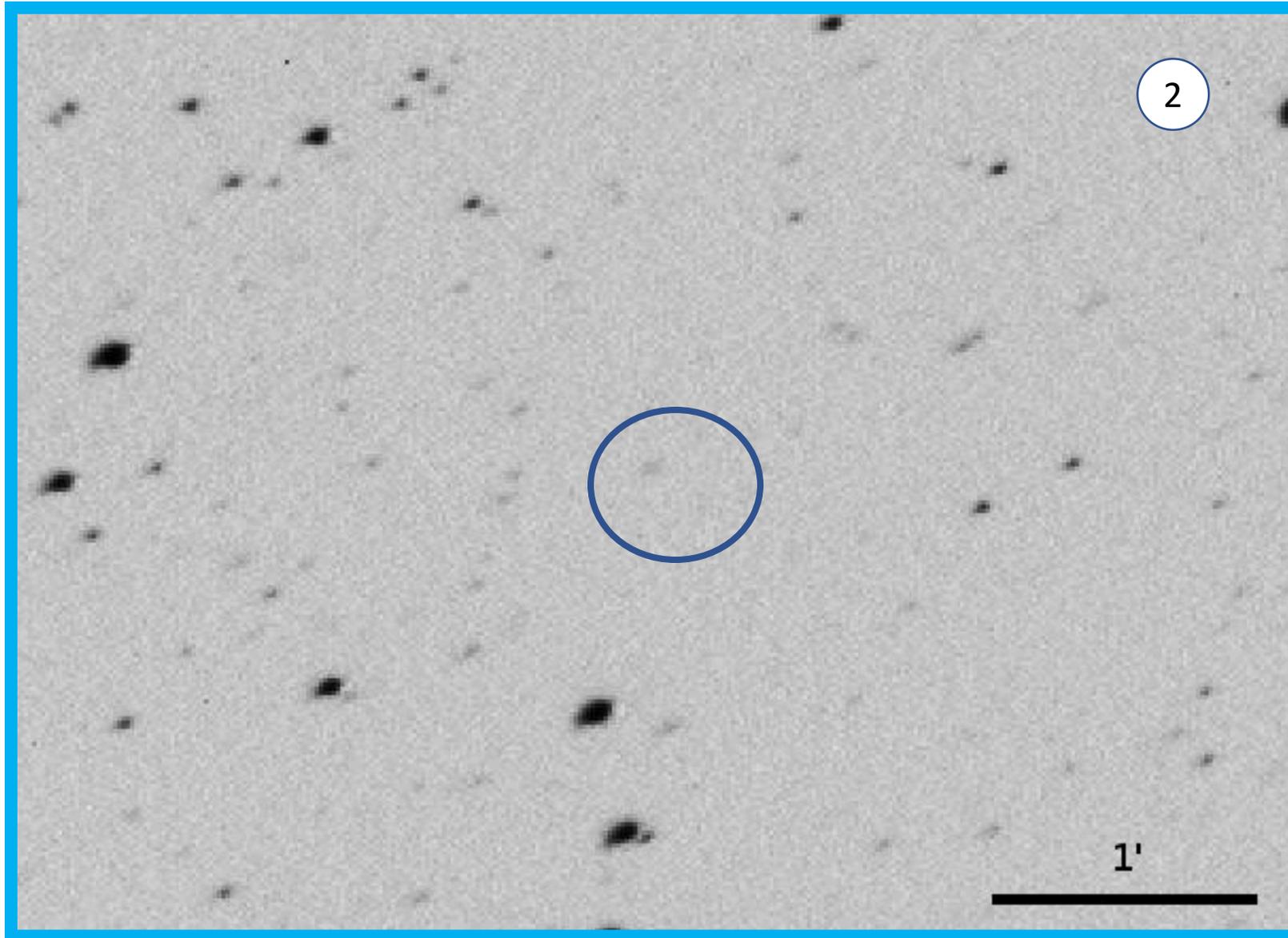
OPTIMA-Burst did what it was supposed to do:
~1 minute after the GRB (28 sec after the notice) the optical search for an
afterglow started at the coarse BAT location...





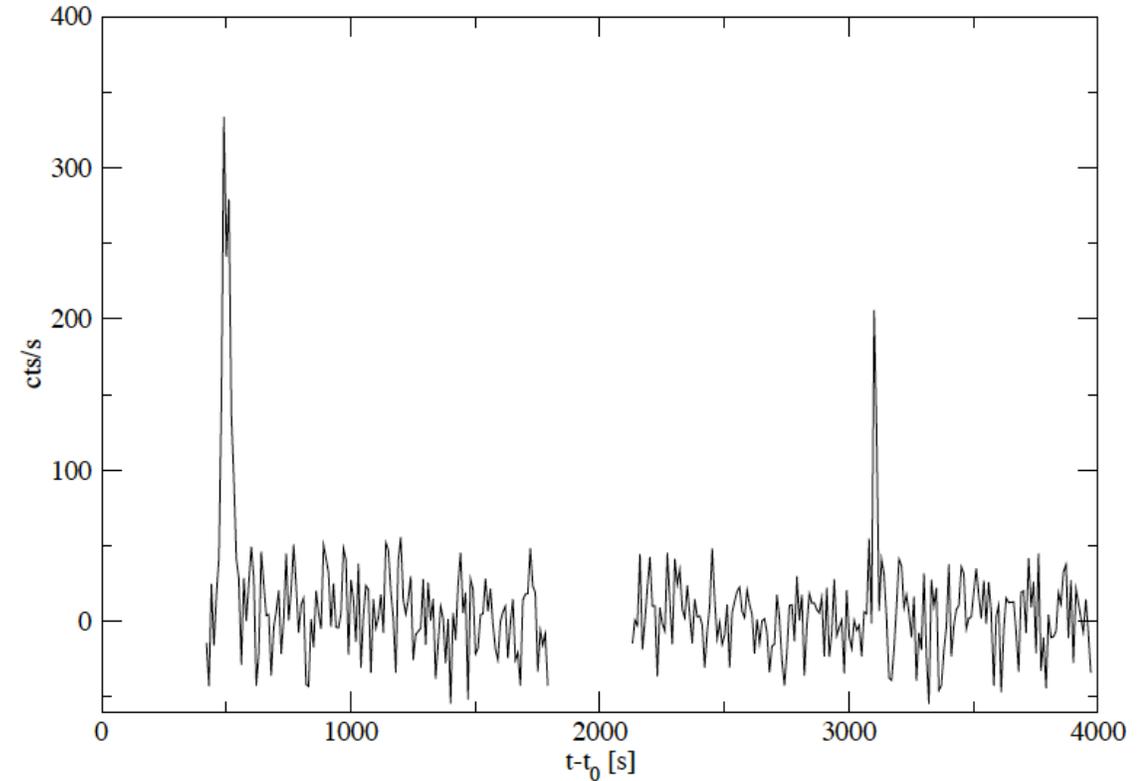
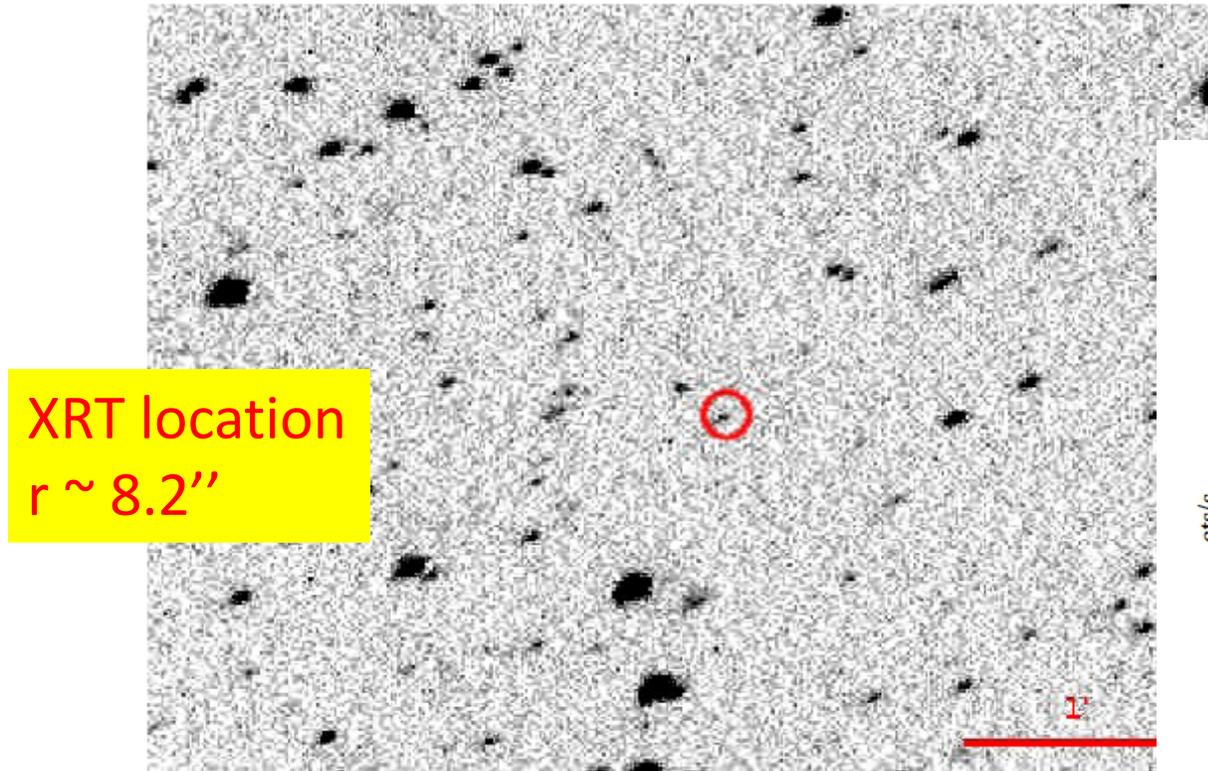


Neil Geehrels Memorial, May 21-22, 2018, Washington, DC



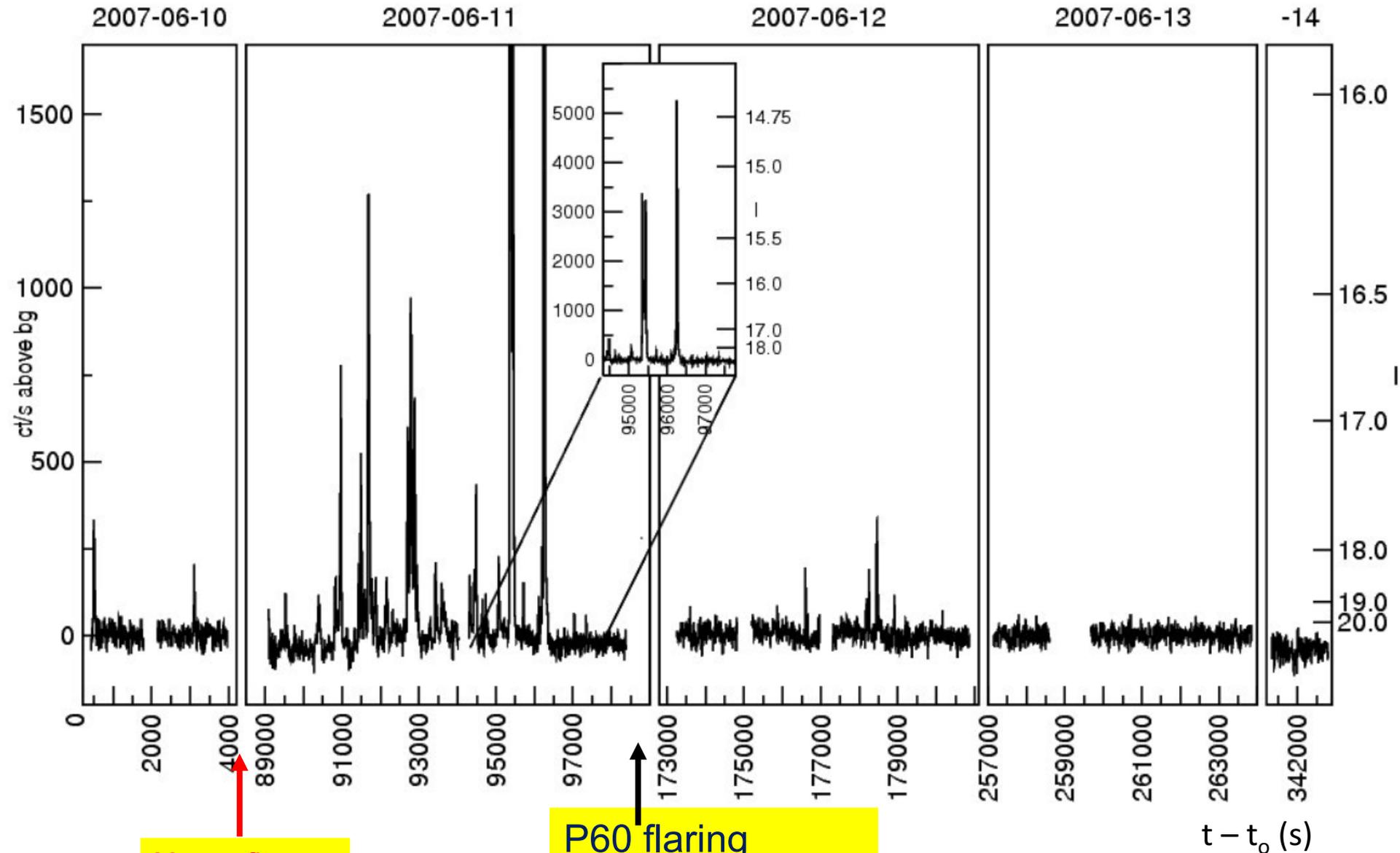
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Very weak OT, marginally visible only in *very first* 10s-exposure. 50 min later confirmed by XRT.

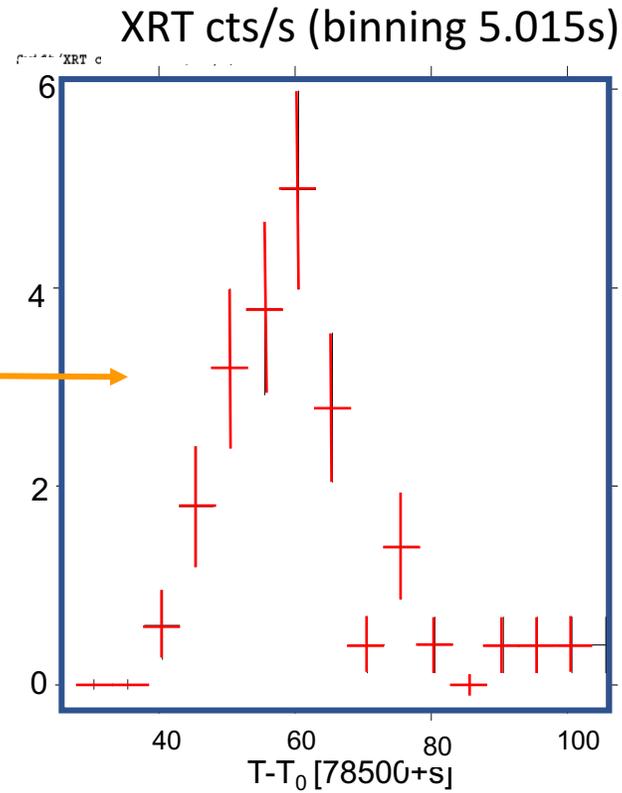
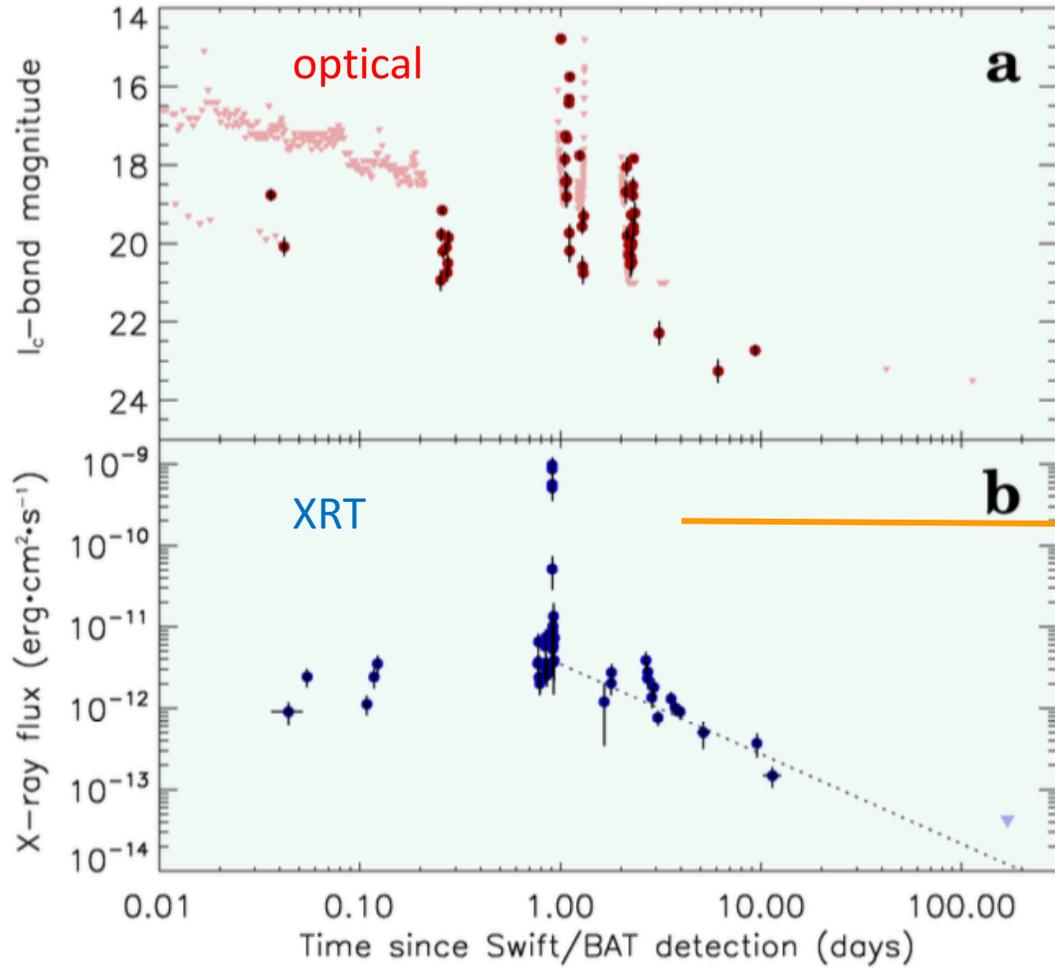


Optical lightcurve during
first hour of
observations

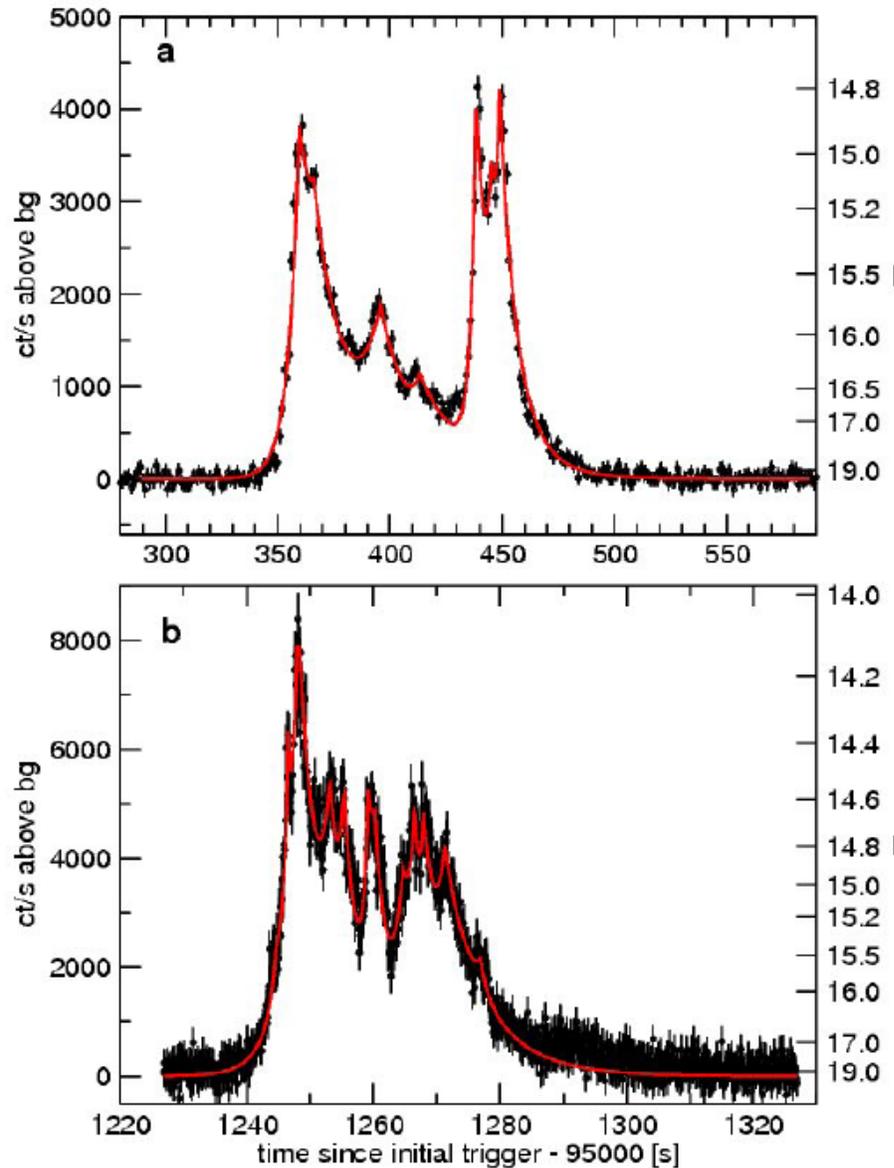
Overview of 5 nights of OPTIMA observations of Swift J1955+26



Compare X-ray and optical lightcurves



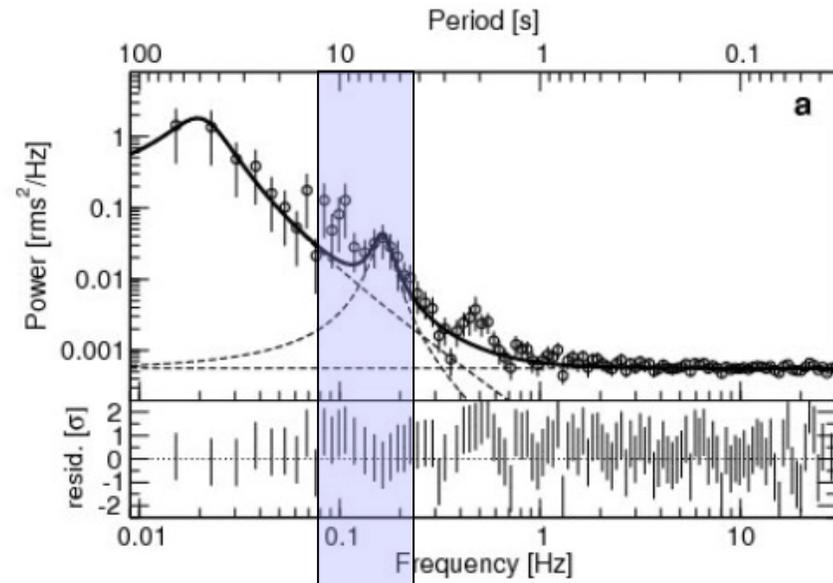
Castro-Tirado et al, 2007, Simon et al, 2012



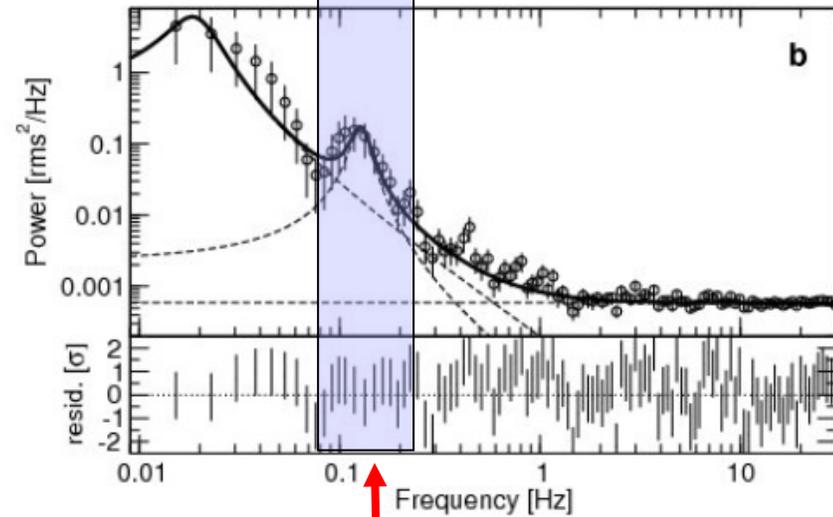
The strongest OPTIMA bursts

- Overlapping fast-rise exponential-decay shaped flares
- Max. magnitude $I \approx 14.1$ mag
 $\hat{=} 1.8 \cdot 10^{35} (d/5 \text{ kpc})^2 \text{ erg s}^{-1}$
- Shortest variability timescales
 $\approx 0.3 \text{ s} \hat{=} 10^{10} \text{ cm}$
- Rising edge $> \times 200$ increase
 in $\approx 4 \text{ s}$
- Subflares seem to repeat on
 $6 - 8 \text{ s}$ timescale

$t-t_0 \sim 95400\text{s}$



$t-t_0 \sim 96260\text{s}$



0.1446 Hz ($\sim 3.4\sigma$, X-ray)
Kasliwal et al., 2008

- A typical magnetar QPO

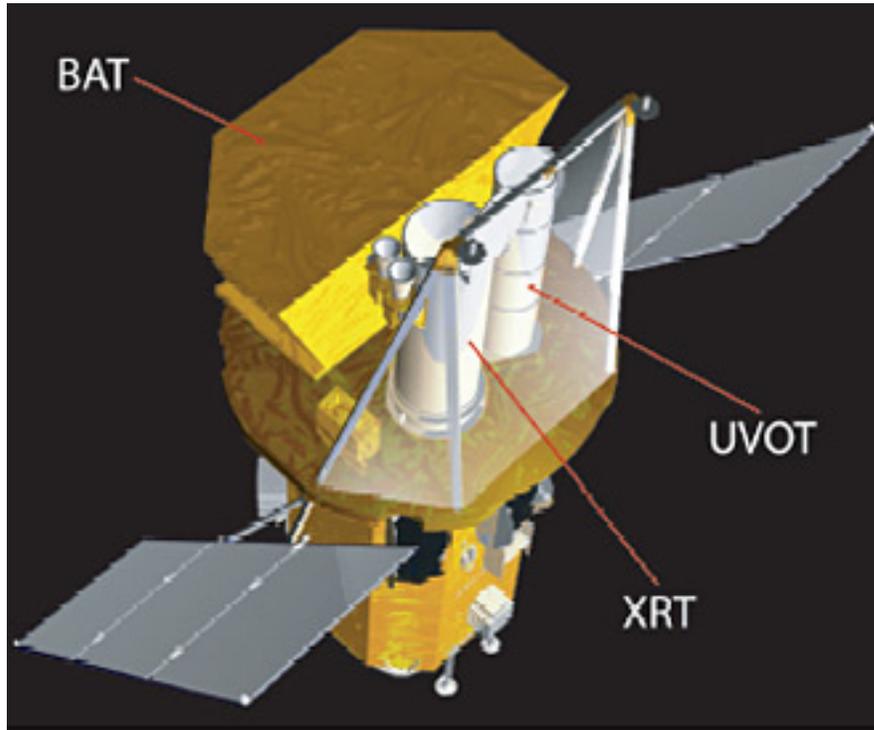
Main observational facts for Swift J1955+26:

- Initially weak bursting on a constant low level
- Strong burst activity appears after 1-2 days
- One initial gamma burst; few strong late X-ray bursts; many optical flares
- X-ray spectrum and galactic extinction suggest distance ~ 5 kpc
- Burst timescales ~ 10 s
- Source disappears after 10's of days in X-rays, optical and IR; no radio detection

Options for Swift J1955+26:

- **BH binary:** type micro blazar (like V4641 Sgr); however stellar companion fainter than K-dwarf
- **Bursting pulsar** like GRO J1744-28; however burst episode seems unique and was never seen before and after
- **Ultracompact low mass binary system**
- **Anomalous X-ray PSR / Soft Gamma Repeater:** typical flares reach 10^{41} erg, J1955+26 only produces 10^{39} erg
- **Magnetar:** with Ion Cyclotron Radiation, Coherent Plasma Bunches, or magnetic reconnection → energetic electron synchrotron emission

Conclusion: The nature of Swift J1955+26 remains a mystery



Thank you Neil and the whole Swift team for making such remarkable rare discoveries possible!

Let's hope we find more of them

“Given our incomplete understanding of many of these phenomena, there is enormous opportunity for more detailed follow-up. **The future is bright for time domain astrophysics.**”

Neil Gehrels and John K. Cannizzo, in ‘High Energy Transient’, 2012 (astro-ph 1207.6346)